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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/761,486 | 01/16/2001 | Wen-Chih Chiou | 67,200-306 | 6239 |

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TUNG & ASSOCIATES
Suite 120
838 W. Long Lake Road
Bloomfield Hills, MI 48302

| EXAMINER |
|---|
| MARKHAM, WESLEY D |

| ART UNIT | PAPER NUMBER |
|---|---|
| 1762 | 2 |

DATE MAILED: 12/12/2001

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/761,486 | CHIOU ET AL. | |
| | Examiner | Art Unit | |
| | Wesley D Markham | 1762 | |

*-- The MAILING DATE of this communication app ars on the cover sheet with the correspondenc addr ss --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *16 January 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

Claims 1 – 17 are currently pending in U.S. Application Serial # 09/761,486, and an Office Action on the merits follows.

### *Drawings*

1. This application has been filed with informal drawings which are acceptable for examination purposes only. Formal drawings will be required when the application is allowed.
2. The drawings are objected to because the data points are not clearly labeled in Figure 4 (i.e., which group of data points relates to the refractive index, "n", and which group of data points relates to the extinction coefficient, "k"?), and neither the axes nor the data points are clearly labeled in Figure 5. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### *Specification*

3. Applicant is reminded of the proper language and format for an abstract of the disclosure. The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited.

4. The disclosure is objected to because of the following informality.

   - Throughout the disclosure, the applicant makes numerous references to the "reflective index, n", and defines it as the ratio of c/v, where c is the light velocity in a vacuum, and v is the light velocity in the material of interest (page 4, lines 4 – 9). Although the examiner notes that the applicant may be their own lexicographer, the art-accepted term for the ratio of c/v is "refractive index", not "reflective index". Therefore, the applicant is suggested to change the appropriate phrases in the specification from "reflective index" to the art-accepted term, "refractive index".

   Appropriate correction is required.

***Claim Objections***

5. Applicant is advised that should Claim 10 be found allowable, Claim 11 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

6. Regarding Claim 12, the applicant makes reference to the "reflective index (n)". This term is defined in the specification as the ratio of c/v, where c is the light velocity in a vacuum, and v is the light velocity in the material of interest (page 4, lines 4 – 9). Although the examiner notes that the applicant may be their own lexicographer, the

art-accepted term for the ratio of c/v is "refractive index", not "reflective index". Therefore, the applicant is suggested to change the phrase in Claim 12 from "reflective index" to the art-accepted term, "refractive index".

7. Regarding Claim 14, the word "coting" in line 5 of the claim appears to be a typographical error. The applicant is suggested to amend the word to read, "coating".

8. Claim 17 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim (i.e., Claim 13). Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Specifically, Claim 17 recites the limitation of "heating said semiconductor substrate to a temperature of at least 600° C...", which does not further limit the limitation, "heating said semiconductor substrate to a temperature between about 400° C and about 1000° C..." in Claim 13.

### *Claim Rejections - 35 USC § 102*

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in-
> (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
> (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United

States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

10. Claims 1 – 2, 5, 8 – 11, and 13 – 16 are rejected under 35 U.S.C. 102(e) as being anticipated by Plat et al. (USPN 6,265,751 B1).

11. Regarding independent Claims 1 and 13, Plat et al. teach a method of depositing and condensing an anti-reflection coating (ARC) layer, the method comprising providing a semiconductor substrate coated with a polysilicon layer on a top surface (Col.4, lines 35 – 39), depositing a dielectric ARC layer on the polysilicon layer, the dielectric layer typically being SiON (Col.4, lines 38 – 39, Col.5, lines 45 – 54), and annealing / heating the dielectric ARC layer deposited on the semiconductor substrate at a temperature of between about 400° C and about 1000° C in a gas / environment comprising at least one of $N_2$ or $O_2$ (Col.6, lines 59 – 65). Specifically, Plat et al. teach annealing at a temperature between 800 and 900 degrees Fahrenheit (i.e., 427° C to 482° C) in an oxygen gas environment. While Plat et al. do not explicitly teach that the method is used for adjusting the optical properties of an ARC layer (Claim 1), or for adjusting the extinction coefficient of the ARC layer (Claim 13), Plat et al. teach performing all the process steps / limitations of the applicant's independent Claims 1 and 13. Therefore, unless essential process limitations are missing from the applicant's claims, the method of Plat et al. would have inherently adjusted the optical properties, such as the extinction coefficient, of the ARC layer.

12. Plat et al. also teach all the limitations of Claims 2, 5, 8 – 11, and 14 – 16 as set forth above in paragraph 11 and below, including a method wherein / further comprising:

- Claim 2 – The step of depositing SiON or SiONH on the SiN or polysilicon layer (Col.5, lines 45 – 54).
- Claim 5 – The gas used in the annealing process is $O_2$ (Col.6, lines 64 – 65).
- Claim 8 – The ARC layer is of a material selected from the group consisting of $SiO_2$, SiON, and SiONH (Col.5, lines 53 – 54).
- Claim 9 – The annealing is performed at a temperature between about 400° C and about 1000° C (Col.6, lines 59 – 65).
- Claims 10 - 11 – The annealing is performed for a time period between about 1 minute and about 30 minutes (Col.6, lines 63 – 64).
- Claim 14 – The heating is performed for a length of time sufficient to vary the extinction coefficient of the ARC layer by at least 10%. While this limitation is not explicitly taught by Plat et al., Plat et al. do teach performing the applicant's claimed process at temperatures in the range claimed by the applicant. In addition, Plat et al. teach an annealing time of up to thirty minutes (Col.6, lines 63 – 64), which is the same upper limit for annealing time contemplated by the applicant. Therefore, unless essential process limitations are missing from the applicant's claims, the method of Plat et al.

would have inherently varied the extinction coefficient of the ARC layer by at least 10%.

- Claims 15 – 16 – The heating is performed for a length of time between about 1 minute and about 30 minutes, specifically between about 3 minutes and about 5 minutes (Col.6, lines 60 – 65).

***Claim Rejections - 35 USC § 103***

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

14. Claims 3 – 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Plat et al. (USPN 6,265,751 B1) in view of Chang et al. (USPN 6,130,146).

15. Plat et al. teach all the limitations of Claim 3 as set forth in paragraph 11 above, except a method wherein the SiON ARC layer is deposited by a plasma enhanced CVD (PECVD) technique. Plat et al. are silent as to how the SiON layer is deposited. Chang et al. teach that, in the art of depositing SiON ARC layers for semiconductor applications, it was known in the art at the time of the applicant's invention to form an SiON ARC layer by a PECVD process (Col.1, lines 41 – 68, Col.2, lines 1 – 7). Therefore, it would have been obvious to one of ordinary skill in the art to deposit the SiON ARC layer of Plat et al. using a PECVD process as

taught by Chang et al. with the reasonable expectation of success (i.e., forming the SiON ARC layer for a semiconductor application, as desired by Plat et al.).

16. The combination of Plat et al. and Chang et al. teach all the limitations of Claim 4 as set forth in paragraphs 11 and 15 above, including a method wherein the SiON is deposited to a thickness of at least 500 Angstroms. Specifically, Plat et al. teach that the desired final SiON ARC layer thickness can be up to 500 Angstroms, and the deposited thickness is preferably about 30% greater than the desired final thickness (Col.5, lines 45 – 67). Thus, the deposited layer thickness is at least 500 Angstroms, as required by applicant's Claim 4.

17. Claims 1 – 2, 6, 8 – 11, and 13 – 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Holscher et al. (USPN 6,274,292 B1) in view of Plat et al. (USPN 6,265,751 B1).

18. Regarding independent Claims 1 and 13, Holscher et al. teach a method for adjusing the optical properties / extinction coefficient of a dielectric ARC (Abstract, Col.2, lines 56 – 67, and Col.3, lines 58 – 60), the method comprising providing a preprocessed semiconductor substrate (Col.2, lines 38 – 55), depositing a dielectric ARC layer on the substrate, the ARC layer preferably being either SiON or SiONH (Col.2, lines 56 – 67), and heating / annealing the semiconductor substrate at a temperature of between about 400° C and about 1000° C in an environment / gas which comprises at least one of $N_2$ or $O_2$ (Col.3, lines 20 – 37). Holscher et al. do not explicitly teach that the ARC layer is deposited on either a SiN or a polysilicon

layer which is provided on the semiconductor substrate. However, it is the intention of Holscher et al. to provide an effective ARC layer that can be used on top of a reflective layer and beneath a photoresist layer to suppress reflected radiation waves from the reflective layer (Col.1, lines 12 – 57). Holscher et al. also teach that the semiconductive substrate on which the ARC layer is deposited includes a semiconductive wafer alone as well as assemblies comprising other materials thereon (Col.2, lines 46 – 55). Plat et al. teach that, in conventional semiconductor devices, an SiON ARC layer is deposited on top of a polysilicon layer to reduce reflections, and a photoresist layer is then patterned on top of the SiON ARC layer (Col.1, lines 21 – 35, Col.2, lines 25 – 30 and 47 – 49). Therefore, it would have been obvious to one of ordinary skill in the art to deposit the ARC layer of Holscher et al. on top of a polysilicon layer as taught by Plat et al. with the reasonable expectation of (1) success, as Holscher et al. teach that their ARC layer can be deposited on either a semiconductor substrate or on a substrate with other materials thereon, and (2) obtaining the benefit of reducing the reflections from the polysilicion layer by depositing the ARC layer on the polysilicon layer prior to photoresist processing, as desired by Holscher et al. and taught by Plat et al.

19. The combination of Holscher et al. and Plat et al. teach all the limitations of Claims 2, 6, 8 – 11, and 14 – 16 as set forth above in paragraph 18 and below, including a method wherein / further comprising:

- Claim 2 – The step of depositing SiON or SiONH on the SiN or polysilicon layer (Col.2, lines 56 – 67 of Holscher et al.).

- Claim 6 – The gas used in the annealing process is $N_2$ (Col.3, lines 33 – 37 of Holscher et al.).
- Claim 8 – The ARC layer is of a material selected from the group consisting of $SiO_2$, SiON, and SiONH (Col.2, lines 56 – 67 of Holscher et al.).
- Claim 9 – The annealing is performed at a temperature between about 400° C and about 1000° C (Col.3, lines 20 – 33 of Holscher et al.).
- Claims 10 - 11 – The annealing is performed for a time period between about 1 minute and about 30 minutes. Specifically, Holscher et al. are silent as to the annealing time period. However, Holscher et al. teach that the annealing is performed to alter at least one of the refractive index or the extinction coefficient of the ARC layer (Col.3, lines 58 – 60). One of ordinary skill in the art would have recognized that the annealing time is a result / effective variable that would have been reasonably expected to influence the final properties of the ARC layer (i.e., the longer the annealing time, the larger the change in the optical properties). Further, Plat et al. teach that it was known in the art at the time of the applicant's invention to anneal a SiON ARC layer for a time period between approximately 5 and 30 minutes (Col.6, lines 63 – 64). Therefore, it would have been obvious to one of ordinary skill in the art to perform the annealing process of Holscher et al. for a time period of between approximately 5 and 30 minutes (as taught by Plat et al.) with the reasonable expectation of success. Further, the exact annealing time would have been optimized through routine experimentation

by one of ordinary skill in the art, depending on the desired change in the optical properties of the ARC layer.

- Claim 14 – The heating is performed for a length of time sufficient to vary the extinction coefficient of the ARC layer by at least 10% (Col.3, lines 55 – 60 of Holscher et al.).
- Claims 15 – 16 – The heating is performed for a length of time between about 1 minute and about 30 minutes, specifically between about 3 minutes and about 5 minutes (See bullet for Claims 10 – 11 above).

20. Claims 3 – 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Holscher et al. (USPN 6,274,292 B1) in view of Plat et al. (USPN 6,265,751 B1) in further view of Chang et al. (USPN 6,130,146).

21. The combination of Holscher et al. and Plat et al. teach all the limitations of Claim 3 as set forth in paragraph 18 above, except a method wherein the SiON ARC layer is deposited by a plasma enhanced CVD (PECVD) technique. However, Holscher et al. do teach that the ARC layer can be deposited by chemical vapor deposition (Col.3, lines 28 – 30). Chang et al. teach that, in the art of depositing SiON ARC layers for semiconductor applications, it was known in the art at the time of the applicant's invention to form an SiON ARC layer by a PECVD process (Col.1, lines 41 – 68, Col.2, lines 1 – 7). Therefore, it would have been obvious to one of ordinary skill in the art to deposit the ARC layer of Holscher et al. using a PECVD process as taught by Chang et al. with the reasonable expectation of success (i.e.,

forming the SiON ARC layer for a semiconductor application, as desired by Holscher et al.).

22. The combination of Holscher et al., Plat et al., and Chang et al. teach all the limitations of Claim 4 as set forth in paragraphs 18 and 21 above, except a method wherein the SiON ARC layer is deposited to a thickness of at least 500 Angstroms. Specifically, Holscher et al. are silent as to the thickness of the SiON ARC layer. However, Plat et al. teach that the antireflective properties of an ARC layer are highly dependent on the thickness of the layer (i.e., the thickness of the ARC layer is a result / effective variable that determines the antireflective properties of the ARC layer) (Col.2, lines 26 – 27). Further, Plat et al. also teach that the desired thickness of the ARC layer may be up to 500 Angstroms (Col.5, lines 58 – 60). Therefore, it would have been obvious to one of ordinary skill in the art to optimize the thickness of the SiON ARC layer of Holscher et al. through routine experimentation, as Plat et al. have disclosed that the thickness of the ARC layer is a result / effective variable that determines the antireflective properties of the ARC layer.

23. Claims 5, 7, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Holscher et al. (USPN 6,274,292 B1) in view of Plat et al. (USPN 6,265,751 B1) in further view of Sandhu et al. (USPN 6,268,282 B1).

24. The combination of Holscher et al. and Plat et al. teaches all the limitations of Claims 5 and 17 as set forth in paragraph 18 above, except a method wherein the

gas / environment used in the annealing process is $O_2$. However, it is the aim of Holscher et al. to anneal an ARC layer such as a SiON or SiONH layer in order to alter at least one of the refractive index or extinction coefficient of the ARC layer (Col.3, lines 58 – 60). Sandhu et al. teach that, when annealing an ARC material in an oxygen environment, the annealing alters the refractive index and the extinction coefficient of the ARC layer (Col.2, lines 35 – 47). Therefore, it would have been obvious to one of ordinary skill in the art to use oxygen as the gas in the annealing process of Holscher et al. with the reasonable expectation of successfully altering at least one of the refractive index or extinction coefficient of the ARC layer as desired by Holscher et al. and taught by Sandhu et al.

25. The combination of Holscher et al., Plat et al., and Sandhu et al. teaches all the limitations of Claim 7 as set forth in paragraphs 18 and 24 above, except a method wherein the gas used in the annealing process is a mixture of $O_2$ and $N_2$. However, Holscher et al. teach that the annealing process gas used can comprise nitrogen (Col.3, lines 35 – 37). In addition, it would have been obvious to one of ordinary skill in the art to use oxygen as the gas in the annealing process of Holscher et al. for the reasons set forth in paragraph 24 above. Therefore, since one of ordinary skill in the art would have expected both oxygen and nitrogen to function effectively as the annealing gas in the process of Holscher.et al., it would have been obvious to one of ordinary skill in the art to use a combination of the two gases with the reasonable expectation of success, absent any showing of criticality or unexpected results of using a mixture of the two gases.

26. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Holscher et al. (USPN 6,274,292 B1) in view of Plat et al. (USPN 6,265,751 B1) in further view of either Lee (USPN 6,300,672 B1) or Yao et al. (USPN 6,258,734 B1).

27. The combination of Holscher et al. and Plat et al. teaches all the limitations of Claim 12 as set forth in paragraph 18 above, except a method wherein the annealing process adjusts the refractive index of the ARC layer to between about 2.0 and 2.5 and the extinction coefficient to between about 0.2 to 0.8. However, Lee teaches that typical SiON ARC layers have a refractive index of about 1.60 – 3.6 and an extinction coefficient of about 0.01 – 2.0 (Abstract and Col.5, lines 25 – 31). Yao et al. teach that key characteristics of an SiON ARC layer include a refractive index of between about 1.85 and 2.35 and an extinction coefficient of between about 0.45 and 0.75 (Abstract and Col.2, lines 9 – 27). Therefore, it would have been obvious to one of ordinary skill in the art to adjust the refractive index of the ARC layer to between about 2.0 and 2.5 and the extinction coefficient to between about 0.2 to 0.8 with the reasonable expectation of (1) success, as Holscher et al. teach that the annealing of an ARC layer such as a SiON or SiONH layer alters at least one of the refractive index or extinction coefficient of the ARC layer, and (2) obtaining the respective refractive index and extinction coefficient values for the ARC layer that are desired in the art, as taught by either Lee or Yao et al.

***Conclusion***

28. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (703) 308-7557. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

29. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (703) 308-2333. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

30. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Wesley D Markham
Examiner
Art Unit 1762

WDM
December 11, 2001

SHRIVE P. BECK
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700